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PROTECTIVE FOOTWEAR

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This invention relates to protective footwear. It relates more specifically to an article of footwear for protecting a wearer against the effects of a landmine explosion, especially an anti-personnel landmine explosion.

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Although the Applicant does not wish to be bound by theory, it is nevertheless believed that a theoretical explanation of some concepts relating to the effects of a landmine explosion will assist the reader in appreciating the inventive contribution which the inventors have made and the principles underlining this invention. Thus, some concepts of relevance are briefly

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explained.

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The Applicant has appreciated that shockwaves play an important role in the field of the invention and, in contra distinction to other inventors in the field, has focused efforts in understanding and dealing with the shock wave effect of a landmine explosion.

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Shock waves are in certain respect equivalent to acoustic waves, for example, progression of a shock wave through a material is not associated with transfer of mass or particles, it progresses as a wave. Furthermore, the speed of progression through a material is dependent on physical properties of the material, i.e. in the case of solid material, speed is proportional to the square root of the ratio of Young's modulus to density of the material. Yet further, the Applicant has appreciated the significance that speed of progression through liquids differ, and is generally lower than that through "rigid" solids such as

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ceramics, metals, and the like, but generally higher than through gasses such as air. Yet further, the role that temperature of a gas plays in respect of acoustic

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CLAIMS:

1. A method of protecting a foot of a human from effects of a landmine explosion underneath said foot, including guiding shock waves caused by the
5 landmine explosion obliquely away from said foot by means of a correspondingly obliquely oriented shock wave guide member embedded in a sole volume of an article of footwear worn by the human.
2. A method as claimed in Claim 1 in which guiding the shock waves
10 is obliquely laterally outwardly.
3. A method as claimed in Claim 1 or Claim 2 in which the shock wave guide member is selected to have a high acoustic speed, higher than 3000
15 m/sec.
4. A method as claimed in any one of Claim 1 to Claim 3 inclusive which includes absorbing heat energy by evaporating liquid contained in the sole volume.
- 20 5. A method as claimed in Claim 4 in which the liquid is proximate the guide member.
6. A method as claimed in any one of Claim 1 to Claim 5 inclusive, in which the shock wave guide member is a composite shock wave guide member
25 comprising a plurality of shock wave guide elements.
7. A method as claimed in Claim 6 in which each shock wave guide element is in the form of a strip of rigid glass containing material, the strips being oriented transversely to allow bending of the article of footwear along transverse
30 bend lines intermediate adjacent strips.

8. A method as claimed in any one of Claim 1 to Claim 7 inclusive which includes attenuating progression of any stray component of the shock wave in a direction toward said foot in the sole volume of the article of footwear by means of a layer of material having a low acoustic speed, lower than about 5 200 m/sec., arranged between the shock wave guide member and an inner sole of the article of footwear.

9. A method as claimed in Claim 8 in which the material is in the form of vermiculite, or a composite material containing vermiculite.

10. A method as claimed in any one of Claim 1 to Claim 9 inclusive, which includes enhancing shock wave progression downstream of the foot by means of a layer of soak-out material in close contact with skin along a foot surface opposite a sole of the foot, the layer of material having an acoustic speed 15 at least equal to acoustic speed of flesh.

11. A method as claimed in Claim 10 in which the acoustic speed of said soak-out material is higher than the acoustic speed of water.

12. A method as claimed in Claim 10 or Claim 11 which includes containing the layer of soak-out material in association with a sock worn by the human.

13. A method as claimed in any one of Claim 1 to Claim 12 inclusive 25 which includes causing spalling of material at a downstream end of the shock wave guide member to create a path of lesser resistance to a blast following the shock waves.

14. A method as claimed in Claim 13 in which spalling is caused along 30 an outer side of said sole volume.

15. A method as claimed in Claim 13 or Claim 14 in which the shock wave guide member is of a material selected to be prone to pulverizing by the shock waves at a speed of crack progression lower than the acoustic speed of said material of the shock wave guide member, the method thus including rendering material along a predetermined route for the ensuing blast, after the shock waves have passed, easily displaceable, to cause said blast to remove said material to create said path of lesser resistance.

16. A method as claimed in Claim 15 in which the material of the shock wave guide member includes glass.

17. An article of protective footwear for a human having a composite sole including an outer sole along one extremity of the article of footwear, a spaced inner sole for seating a foot of a user, and a sole volume intermediate the outer and the inner soles, the composite sole including in said sole volume a shock wave guide member oriented to guide shock waves caused by a landmine explosion obliquely away from said foot in use.

18. An article of footwear as claimed in Claim 17 in which the shock wave guide member extends from about the outer sole obliquely upwardly to a laterally outward extremity of the composite sole.

19. An article of footwear as claimed in Claim 17 or Claim 18 in which the shock wave guide member is of solid material having an acoustic speed higher than 3000 m/sec.

20. An article of footwear as claimed in Claim 19 in which the shock wave guide member is of, or contains, glass.

21. An article of footwear as claimed in any one of Claim 17 to Claim 20 inclusive in which the composite sole volume contains a liquid proximate the shock wave guide member.
- 5 22. An article of footwear as claimed in any one of Claim 17 to Claim 21 inclusive, in which the shock wave guide member is of composite structure comprising a plurality of shock wave guide elements.
- 10 23. An article of footwear as claimed in Claim 22 in which each shock wave guide element is in the form of a strip of rigid, glass or glass containing material, the strips being oriented transversely and arranged adjacent one another to allow bending of the article of footwear along transverse bend lines intermediate adjacent strips.
- 15 24. An article of footwear as claimed in any one of Claim 17 to Claim 23 inclusive, which includes, between the shock wave guide member and the inner sole, a layer of blocking material having an acoustic speed lower than about 200 m/sec.
- 20 25. An article of footwear as claimed in Claim 24 in which the blocking material is vermiculite, or a composite material containing vermiculite.
- 25 26. An article of footwear as claimed in any one of Claim 17 to Claim 25 inclusive which includes a foot surrounding upper defining a foot cavity above the inner sole, and a layer of soak-out material in fluid form and having an acoustic speed equal to or higher than the acoustic speed of flesh and arranged to be in close contact with skin at a surface of the foot opposite a sole of the foot in use.
- 30 27. An article of footwear as claimed in Claim 26 in which the soak-out material has an acoustic speed higher than that of water.

28. An article of footwear as claimed in Claim 27 in which the soak-out material is or includes glycerin.

29. An article of footwear as claimed in Claim 26, Claim 27, or Claim 28
5 in which the soak-out material is contained in a closed, flexible container such as a pad or sachet.

30. An article of footwear as claimed in any one of Claim 26 to Claim 29
10 inclusive in which the soak-out material is provided in amongst granular or filamentary material having an acoustic speed higher than the acoustic speed of the soak-out material.

31. The combination of an article of footwear as claimed in any one of
15 Claim 26 to Claim 30 inclusive, and a sock, in which the soak-out material is contained in the sock.